Gypsy Moth News

Issue No. 37 January 1995

How gypsy moth outbreaks change the forest

David A. Gansner uses Pennsylvania data to describe an answer

In this issue -

TABLE OF CONTENTS

Editor Daniel B. Twardus
Assistant Editor for Research Michael L. McManus
Managing Editor Helen A. Machesky
Editorial Review Gerard Hertel
Internet Facilitator Andrew Liebhold
Production Assistant Melissa A. Emerson
Circulation Stephen C. Smith

Gypsy Moth News is a service of the USDA Forest Service, Northeastern Area State and Private Forestry.

The *News* is distributed periodically to individuals and organizations. Products mentioned by name within articles are not necessarily endorsed by the USDA. Use of graphics or reprints of articles should cite the *Gypsy Moth News* as their source.

Articles submitted to the *Gypsy Moth News* are subject to editing for length, grammar, and clarity.

Address correspondence to the Editor:

USDA Forest Service
Forest Health Protection
180 Canfield Street
Morgantown, WV 26505

FROM THE EDITOR

Who is State and Private Forestry? The name, State and Private Forestry (S&PF), refers to USDA Forest Service activities or programs that affect non-federal forest lands. The roots of this Federal influence upon non-federal lands go back to Gifford Pinchot. During the late 1800's when Pinchot first arrived in the Department of Agriculture, all Federal lands were then administered by the Department of Interior. Lacking any of its own lands to manage, the newly formed Division of Forestry extended an invitation to "farmers, lumbermen, and other owners of forestlands" for free assistance in developing working forestry plans. According to one account, by the end of the first year, 123 requests from 23 States arrived and cooperative forestry was born in America. Today, we find State and Private Forestry cooperative programs involving forest management plans, urban forestry, fire control, and insect and disease control. All S&PF programs are directed through the State Foresters. This linkage between S&PF and the State Foresters finds its origin in the Weeks Act of 1911 which authorized spending Federal matching funds for States with forest protection agencies that met Federal standards. In this way, the Forest Service became a significant influence in promoting the development of State forestry organizations--a partnership which lasts today.

The *Gypsy Moth News* is produced as a service of State and Private Forestry. Through the *News*, we try to keep the State Foresters, Federal forest managers, State and Federal pest specialists, and other interested individuals informed about the status of the gypsy moth in the U.S., progress in research, and developments in managing this pest and its impacts.

What would happen if we did not produce the *Gypsy Moth News*? Over the years, we have provided status reports detailing current outbreak information including acres of defoliation and acres sprayed. We have brought research results to the pages of the *News* including the current article about changes in forest susceptibility.

The *News* has been a focal point for new information such as the global positioning system discussed in this issue. And, our letters to the editor have been a way for us (as a service organization) to find out about the questions and concerns of a widespread and diverse audience.

We hope you like the *News*. If you do, let us know. And, if you have suggestions for improvement, we would like to hear about them, too.

-DBT

Gypsy Moth Status Report

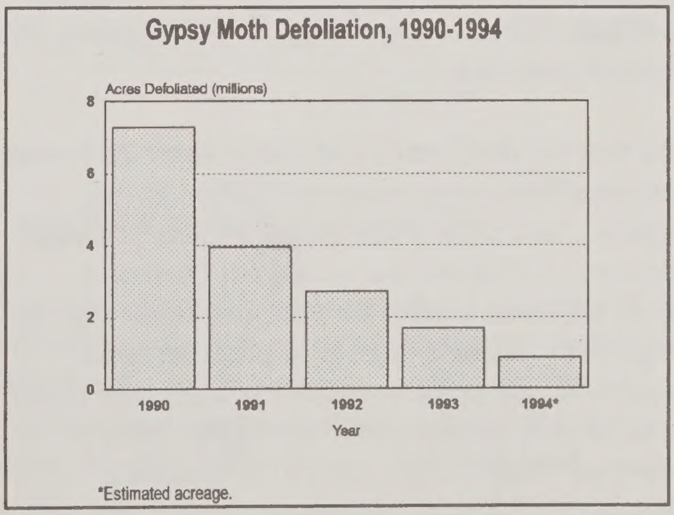
Debra Allen-Reid
Entomologist, USDA Forest Service
Forest Health Protection
Morgantown, WV 26505

Judging from 1994 defoliation figures, populations appear to be declining in all areas except the mid-Atlantic coast, with Delaware and eastern Maryland showing the only increases since last year.

The harsh winter of 1993-94 may help explain the drop in population numbers seen in some areas of the generally infested eastern U.S. Sustained low temperatures, in the negative 20 degrees F vicinity and lower, left pockets of unhatched egg masses throughout the region. Unfortunately, the key word here was "pockets" as the mortality was not extensive enough to justify broad scale curtailment of suppression activities. Noticeable viability differences in egg masses located above versus below the snowline made evaluation of the winter-kill difficult. Program managers realized that the only way to evaluate the winter mortality would be to re-survey each block scheduled for treatment. In most cases, this was determined to be time- and cost-prohibitive. Some states have clauses in their aerial spray contracts allowing for a reduction in treatment acreage but determining which acres to eliminate from the project was still a problem. Unnecessary treatment is a concern, but until reliable, operationally feasible methods for predicting and assessing winter mortality are available, managers will not be willing to risk eliminating heavily infested acreage from a project.

Considerable egg mass mortality and declines in defoliated acreage were observed in Michigan and Ohio. Pennsylvania experienced its fifth consecutive year of declining defoliation, but is detecting increasing populations in some traditional hotspots, including the southeastern part of the State. For this reason, they are expecting an increase in defoliation over the next few years. West Virginia reports a collapse in eastern panhandle populations. Although a reduction from last year, Virginia had the highest number of defoliated acres of any state, most of it in the susceptible host type of the mountains. Treatment acres, however, are expected to increase due to the continuing development of leading edge populations and a rebound of activity in northern Virginia.

While populations are down in New England, the south shores of Massachusetts and Rhode Island witnessed heavier defoliation than anticipated. Similar conditions existed in New Jersey where overall defoliation was down 30 percent from 1993 levels. Delaware and Maryland both had higher defoliation levels in 1994 than in 1993. Viability checks in the ridge and valley region of western Maryland indicated that egg masses survived frigid temperatures only to succumb later to a cold snap following a warm period. Delaware's geography allowed it to escape the extreme cold temperatures and the entire state is seeing significant increases in population levels. Defoliation in 1994 was the highest ever seen in Delaware and early egg mass survey results indicate extremely heavy and healthy populations.



Maryland Gypsy Moth Suppression Program, 1994

Mark Taylor
Gypsy Moth Coordinator
Maryland Department of Agriculture
Annapolis, MD 21401

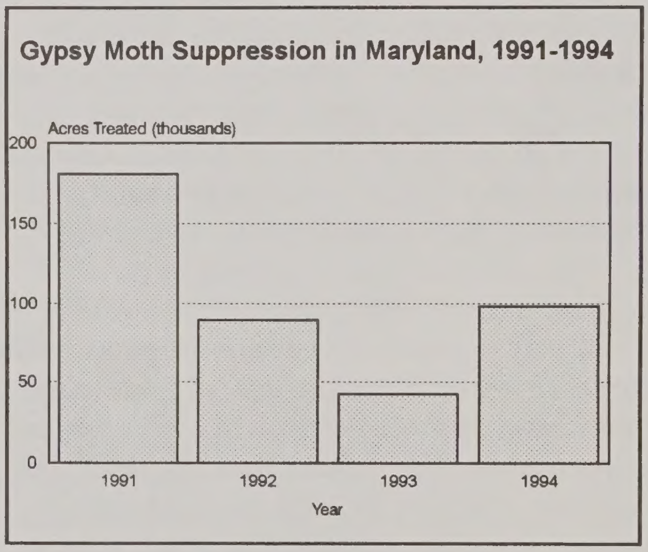
In 1993, the Maryland Department of Agriculture conducted the smallest suppression program to date. Fall 1993 egg mass surveys indicated that most of the Northeast and Central areas of Maryland continued to have low gypsy moth populations. Results, however, showed that the two western most counties, the Eastern Shore counties and Southern Maryland would experience dense populations of gypsy moth caterpillars in the spring of 1994.

Four aerial spray contracts were let for the cooperative suppression program and one small contract was dedicated to research conducted by the USDA Beltsville Agriculture Research Center (ARS).

Spraying began on April 27 on the Eastern Shore and on May 2 in Southern Maryland and the Central Region. In Garrett County, which is in the Western Region, spraying began on May 10, but was suspended until May 24 because cold weather delayed foliage expansion and caterpillar development.

A total of 96,561 acres were sprayed in 1994. Of this total, 370 acres were sprayed with Gypchek for research purposes.

This was the third year MDA has offered the Forest Resource Protection Initiative (FRPI). In this program, landowners who manage tracts of forests in excess of 25 acres that would not otherwise satisfy the State criteria for selection, could join the program by paying a portion of program costs. Residential and public recreational lands rank higher in the priority system due to the higher value of individual trees and the public's intolerance of mortality and dieback of trees on residential sites. Much of this "intolerance" is due to the need to remove dead and dying trees due to the safety hazard they pose and the high cost of their removal. The program is coordinated by local Forestry Boards, with MDA Forest Pest Management conducting all aspects of the suppression program (survey, notification, application, etc.). In 1994, MDA sprayed 3,796 acres through this program.



Technology Update

Tracking Changes in the Susceptibility of Forest Land Infested with Gypsy Moth

David A. Gansner, John W. Quimby, Susan L. King, Stanford L. Arner, and David A. Drake

Introduction

Resource and pest managers are constantly being challenged to show that the benefits of gypsy moth (*Lymantria dispar* L.) control outweigh the costs. To deal objectively with this issue, they need a better understanding of the consequences of doing nothing—what happens to infested woodlands if you don't control the pest? In this regard, Jim Nelson (State Forester of Pennsylvania) asked us to help answer a specific question: Does forest land that has been subjected to intensive outbreaks become less susceptible to gypsy moth defoliation?

The forests of south-central Pennsylvania (Fig. 1) provide an excellent contemporary example of a resource that came under heavy attack from the gypsy moth during the 1980's. Infestation cycles were typical of the gypsy moth's traditional modus operandi, that is, noticeable defoliation during 1981-83 and again during 1985-87 with peak levels in 1982 and 1986.

Defoliation combined with drought, cutting, deer browsing, and other stresses took a heavy toll on the region's oak resource. During the 1980's, mortality and cutting removed about 40 percent of the original inventory of oak growing stock. Growth on residual oak trees offset much of the loss, but not enough to keep the volume of oak from declining between inventories (Gansner et al. 1993). Losses were especially noticeable in smaller size trees. At the same time, other species such as red maple, pine, hemlock, birch, blackgum, ash and yellow-poplar, which are less susceptible to gypsy moth, prospered. Certainly, these trends would suggest a change in susceptibility.

We are fortunate that a comprehensive reinventory of forest land in south-central Pennsylvania was completed for 1989 (Alerich 1993). A model that estimates defoliation potential can be applied to data from 415 plots remeasured in that survey. This allows us to quantify and analyze shifts in susceptibility that have occurred in the region since the last inventory in 1978.

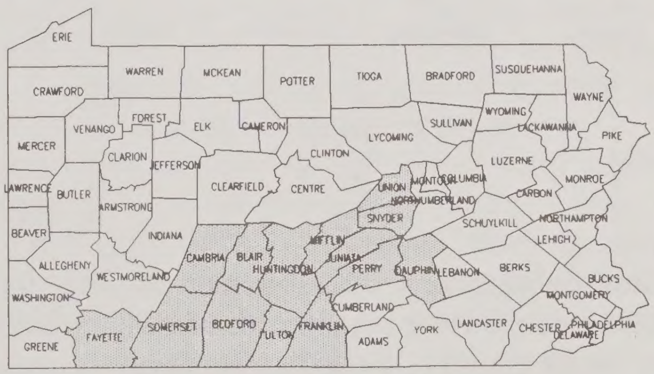


Figure 1.--The study area in south-central Pennsylvania.

Guide For Estimating Susceptibility

One model for gauging the likelihood of gypsy moth defoliation was developed in central Pennsylvania by Herrick and Gansner (1986). It links defoliation potential (expressed as average defoliation expected during a 3-year outbreak) to key forest-stand characteristics as predictor variables. The model can be used to rate the relative susceptibility of forest stands. For example, stands with the highest

potential for defoliation have at least 80 percent basal area in oak species, at least 70 percent in chestnut and black oaks, and at least 60 percent in trees with good crowns. Stands with the lowest rating have less than 20 percent basal area in oaks.

Checking on Model Performance

Does the guide for estimating susceptibility work? To find out, we ran a test of validity on the 415 remeasured inventory plots in south-central Pennsylvania. First, we used the model to predict the defoliation potential of each plot, employing plot characteristics recorded in 1978. That was before the gypsy moth got into high gear in this region. Only three of the four variables included in the defoliation potential model could be used in the analysis. Crown condition was not measured by forest inventory crews and no appropriate surrogates for the crown condition variable are available. This is not a serious concern because crown condition does not account for a large amount of the variation in defoliation. The 415 plots were classified and sorted into six distinct groups of defoliation potential (in percent):

Group	Defoliation potential (1978)	Number of Plots
1	9	140
2	18	96
3	24	52
4	27	62
5	28	30
6	35	35

Next, estimates of *actual* defoliation occurring from 1978 through 1989 were recorded for plots in each of the six groups of defoliation potential. To obtain these estimates, optical bar photography and sketch maps showing amounts and intensity of actual annual defoliation were overlayed on plot locations.

Finally, averages of actual defoliation for the plots in each defoliation potential group were compared with predicted values for the groups (Fig. 2). Averages of actual defoliation for 1985 through 1987 were used. These 3 years encompassed a period of intensive defoliation in the region. Use of average defoliation for a 3-year period of outbreak is consistent with the procedure used to develop the defoliation potential model.

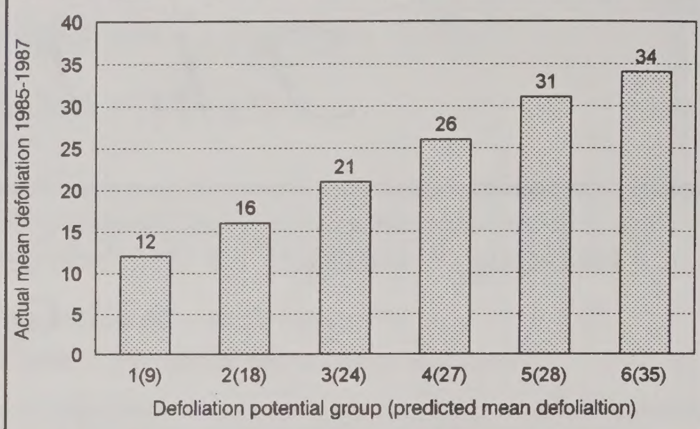


Figure 2.–Comparison of actual mean defoliation (1985-1987) with predicted potential–southcentral Pennsylvania.

Results of this test indicate that, as a measure of relative susceptibility, the model appears to work well. For example, the model assigned 140 plots to Group 1, which had a mean defoliation potential of only 9 percent. Actual defoliation recorded for the 140 plots in Group 1 averaged only 12 percent. At the other end of the scale, 35 plots were assigned to Group 6, which had a relatively high mean defoliation potential of 35 percent. Actual defoliation for these 35 plots averaged 34 percent.

There was a significant amount of variation in actual mean defoliation for plots within each group. For example, actual defoliation for 2 of the 30 plots in Group 5 averaged 62 percent, while no noticeable defoliation was recorded for 2 other plots in this group. For half of the plots in Group 5, actual mean defoliation ranged from 15 to 47 percent. Actual defoliation for all plots in Group 5 averaged 31 percent. The predicted mean was 28 percent.

Fosbroke and Hicks (1993) evaluated the performance of this same model on plots in the Ridge and Valley province of Maryland and in the Appalachian Plateau of Pennsylvania. Our findings are in basic agreement with theirs. The model's best use is for rating relative susceptibility, that is, for separating stands at risk of heavy defoliation from those where defoliation is likely to be light—and not for predicting actual defoliation in a given stand.

The Region's Forest is Less Susceptible

Application of the defoliation potential model to forest inventory plot data for 1978 and 1989 allowed us to quantify trends in the susceptibility of south-central Pennsylvania's forest resource during a period of intensive infestation by the gypsy moth. By design, each plot represents a proportional share of the forest area in a county, so appropriate weights could be applied to susceptibility ratings for individual plots to derive average ratings for each county. Results of this analysis show that defoliation potential is down in all of the region's 14 counties:

County	1978	1989	Percent Change
Bedford	20.2	17.2	-15
Blair	19.8	19.2	-3
Cambria	14.5	11.9	-18
Dauphin	23.3	19.4	-17
Fayette	15.2	15.1	-1
Franklin	21.7	18.3	-16
Fulton	20.0	18.7	-7
Huntingdon	18.3	16.7	-9
Juniata	21.2	17.7	-17
Mifflin	25.7	21.8	-15
Perry	21.9	20.4	-7
Somerset	14.9	13.6	-9
Snyder	18.3	17.6	-4
Union	20.7	18.3	-12

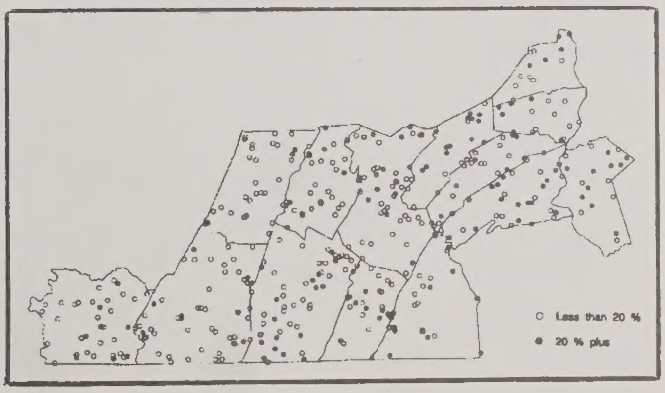


Figure 3.--Change in defoliation potential for plots in south-central Pennsylvania, 1978-89.

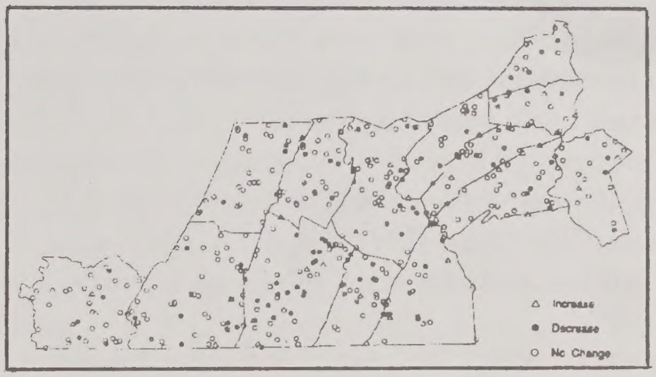


Figure 4.--Defoliation potential of south-central Pennsylvania plots, 1989.

This is not to say that gypsy moth is no longer a threat here. In fact, despite the declines in potential, susceptibility ratings for the region's counties remain relatively high. By comparison, Erie, McKean, Sullivan, and Susquehanna Counties, in parts of the State where oaks are not so plentiful, had average ratings of less than 10 in 1989.

Locations of the 415 forest inventory plots have been digitized, so changes in defoliation potential for individual plots can be mapped. This map provides a more specific view of trends in susceptibility (Fig. 3). Two-thirds of the plots remained in the same defoliation potential class between inventories. However, 26 percent shifted to a lower rating while percent shifted to a higher one. So on a plot basis, losers in susceptibility outnumbered gainers by more than 3 to 1. In 1978, more than 40 percent of the plots had ratings of 20 or more. By 1989, one-third of them were still in this category (Fig. 4). This reinforces the notion that, even though susceptibility of the region's forest has declined, the potential for future defoliation remains relatively high.

Implications

Does forest land subjected to intensive defoliation by gypsy moth become less susceptible to the pest? Results of this analysis would indicate that indeed it does. And there is other related news--some good and some bad, depending on your perspective. The species composition of south-central Pennsylvania's

forest resource is more diverse now than it was 15 years ago. Also, many areas that were decimated by heavy mortality and cutting are regenerating to provide badly needed habitat for wildlife species that require early successional ecosystems. On the down side, there is less oak than there used to be and much of the timber that died cannot be salvaged. This is bad news for wood-producing interests.

Some care should be taken in extending specific results of this case study to other regions. Factors other than the gypsy moth such as drought, cutting, bark beetles, root rot, and deer browsing contributed to the declines in oak that led to reductions in the susceptibility of south-central Pennsylvania's forests. Effects of these other factors will vary from place to place. Also, characteristics of the region's forests are somewhat different from those on new frontiers of infestation. Who can say whether a post oak in the Ozarks of Missouri or sweetgum on the Coastal Plain of South Carolina will hold the same attraction for gypsy moth as a chestnut oak on a ridge in south-central Pennsylvania.

Literature Cited

Alerich, Carol L. 1993. **Forest statistics for Pennsylvania, 1978-1989.** Resour. Bull. NE-126. Radnor, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 244 p.

Fosbroke, David E.; Hicks, Ray R., Jr. 1993. **Predictability of gypsy moth defoliation in central hardwoods: a validation study.** In: Proceedings of the 9th central hardwood forest conference; 1993 March 8-10; West Lafayette, IN. Gen. Tech Rep. NC-161. St Paul, MN: U.S. Department of Agriculture, Forest Service, North Central Forest Experiment Station: 156-170.

Gansner, David A; Arner, Stanford L; Widmann, Richard H.; Alerich, Carol L. 1993. **What's happening to Pennsylvania's oaks?** In: Finley, James C.; Jones, Stephen B., eds. Penn's Woods--change and challenge: proceedings of the 1993 Penn State forest resources issues conference; 1993 April 1-2; State College, PA. State College, PA: Pennsylvania State University: 15-22.

Herrick, Owen W.; Gansner, David A. 1986. **Rating forest stands for gypsy moth defoliation.** Res. Pap. NE-583. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station. 4 p.

About the Authors

David A. Gansner (retired), Susan L. King, Stanford L. Arner, and David A. Drake are resource analysts with the Forest Inventory and Analysis work unit at the USDA Forest Service's Northeastern Forest Experiment Station, Radnor, PA.

John W. Quimby is a forest pest management specialist with the Division of Forest Pest Management, Pennsylvania Department of Environmental Resources, Bureau of Forestry, Middletown, PA.

A Research and Scientific Exchange

Title of Exchange

Use of Microsporidia for Classical Biological Control of the Gypsy Moth

Team Members

Michael L. McManus, Supervisory Research Entomologist, Northeastern Forest Experiment Station, Northeastern Center for Forest Health Research, 51 Mill Pond Road, Hamden, CT. 06514; (203) 773-2028; Fax: (203) 773-2183; Joseph V. Maddox, Entomologist, Center for Economic Entomology, Illinois Natural History Survey, 172 Natural Resources Building, 607 E. Peabody Drive, Champaign, IL 61820; (217) 244-5115; FAX (217) 333-6784

Countries Visited

Austria, June 1-4, 1994
Slovak Republic, June 5-11, 1994
Czech Republic, June 12-19, 1994

Objectives of the Exchange

The objectives of this exchange were to collect gypsy moth specific microsporidia from the Czech and Slovak Republics and neighboring countries, identify the isolates and clarify their taxonomy, and evaluate candidate species for their introduction and establishment in North American gypsy moth populations to facilitate classical biological control.

Drs. Michael McManus and Joseph Maddox visited Forestry Institutes in Austria, Slovack Republic, and the Czech Republic in June, 1994. With assistance from cooperating scientists at these Institutes, they obtained 3-5 new isolates of gypsy moth specific microsporidia from gypsy moth populations over a broad geographical area and from a diversity of host plants native to those countries. Based on preliminary evaluations, many of these isolates are different from pathogens that have been described in the European literature and thus should provide us with several good candidates for introduction into North America for classical biological control of the gypsy moth.

WhoIs

By no means a complete list, but here is a good starter for people to call when questions arise. Summer of '95--look for a complete "WhoIs" directory in the *Gypsy Moth News*.

WHO IS THE EXPERT I CAN TALK TO:

Aircraft calibration and spray swath characterization

Just completed comprehensive evaluation of DC-3 spray swath, C130, and Air Tractor 802

⇨ **John Ghent**, USDA Forest Service, Asheville, NC, (704) 257-4328

Contact for information about spray models--FSCBG and AGDISP, fate and dispersion of pesticides in the environment, and spray drift of *B.t.*

⇨ **Jack Barry**, USDA Forest Service, Davis, CA, (916) 758-4600

Several years of hands-on experience calibrating and characterizing aircraft for State spray projects

⇨ **Bill Buzzard**, Pennsylvania Bureau of Forestry, Middletown, PA, (717) 948-3941

Over a decade of hands-on calibration experience. Also, has experience with project planning, Environmental Assessments, and contracting.

⇨ **Brad Onken,** USDA Forest Service, Morgantown, WV, (304) 285-1546

Spray Project Organization

Over 10 years of experience organizing and running State-wide gypsy moth suppression. Runs landowner cost share program.

⇨ **Jan Hacker**, WV Dept. of Agriculture, Charleston, WV, (304) 558-2212

Many years of experience running large projects in densely populated (as in people) State.

⇨ **John Kegg**, New Jersey Department of Agriculture, Trenton, NJ, (609) 292-5440

Has coordinated National Forest suppression projects for several years.

⇨ **Don Clymer**, USDA Forest Service, Warren, PA, (814) 723-5150

Surveys and Sampling

Wrote the book on egg mass surveys--ask for it.

⇨ **Sandy Liebhold**, USDA Forest Service, Morgantown, WV, (304) 285-1609

Does egg mass surveys for State program. Supervises field crews.

⇨ **Norman Dean**, West Virginia Department of Agriculture, Inwood, WV, (304) 229-5828

Contract Development

Writes contracts for Forest Service suppression projects.

⇨ **John Ghent**, USDA Forest Service, Asheville, NC, (704) 257-4328

Contract has been used as a model by other projects.

⇨ **Don Eggen**, Delaware Department of Agriculture, Dover, DE, (302) 739-4811 Ext. 259

Aerial Sketchmapping

Several years of sketchmapping experience. Knows about Forest Health Monitoring survey standards.

⇨ **Marc Roberts**, USDA Forest Service, St. Paul, MN, (612) 649-5268

Several years of sketchmapping experience. Also does egg mass surveys.

⇨ **Rod Whiteman**, USDA Forest Service, Morgantown, WV, (304) 285-1555

Several years of experience with sketchmapping and aerial surveys..

⇨ **Karen Felton**, USDA Forest Service, Morgantown, WV, (304) 285-1556

NEPA

Coordinates NEPA compliance for several State projects.

⇨ **Debra Allen-Reid**, USDA Forest Service, Morgantown, WV, (304) 285-1557

Allegheny National Forest Environmental Analysis team leader with several years of experience.

⇨ **Bob White**, USDA Forest Service, Warren, PA (814) 723-5150

Environmental Impact Statement team leader.

⇨ **John Hazel**, USDA Forest Service, Radnor, PA, (610) 975-4183

Gypsy Moth Biology, Population Dynamics and Spread

Developed gypsy moth spread map.

⇨ **Sandy Liebhold**, USDA Forest Service, Morgantown, WV, (304) 285-1609

Co-authored comprehensive publication detailing population dynamics.

⇨ **Joe Elkinton**, University of Massachusetts, Amherst, MA (413) 545-2284

Knows about gypsy moth pathogens.

⇨ **John Podgwaite**, USDA Forest Service, Hamden, CT, (203) 773-2028

Knows about the laboratory rearing of gypsy moths.

⇨ **Tom O'Dell**, USDA Forest Service, Hamden, CT, (203) 773-2024

Use of Insecticides

Knows how *B.t.* really works.

⇨ **Norm Dubois**, USDA Forest Service, Hamden, CT, (203) 773-2183

Expertise in the use of Gypchek.

⇨ **Richard Reardon**, USDA Forest Service, National Center for Forest Health Management, Morgantown, WV, (304) 285-1566

Forest insect virology.

⇨ **John Podgwaite**, USDA Forest Service, Hamden, CT, (203) 773-2033

Global Positioning System

Hands-on GPS experience with Michigan system.

⇨ **Frank Sapio**, Michigan Department of Natural Resources, East Lansing, MI, (517) 335-3347

Would you like to be added to this directory of expertise and experience? Send us your name, address, telephone, and e-mail address. Give us a brief description of your area of expertise and any specific experience you want to be included.

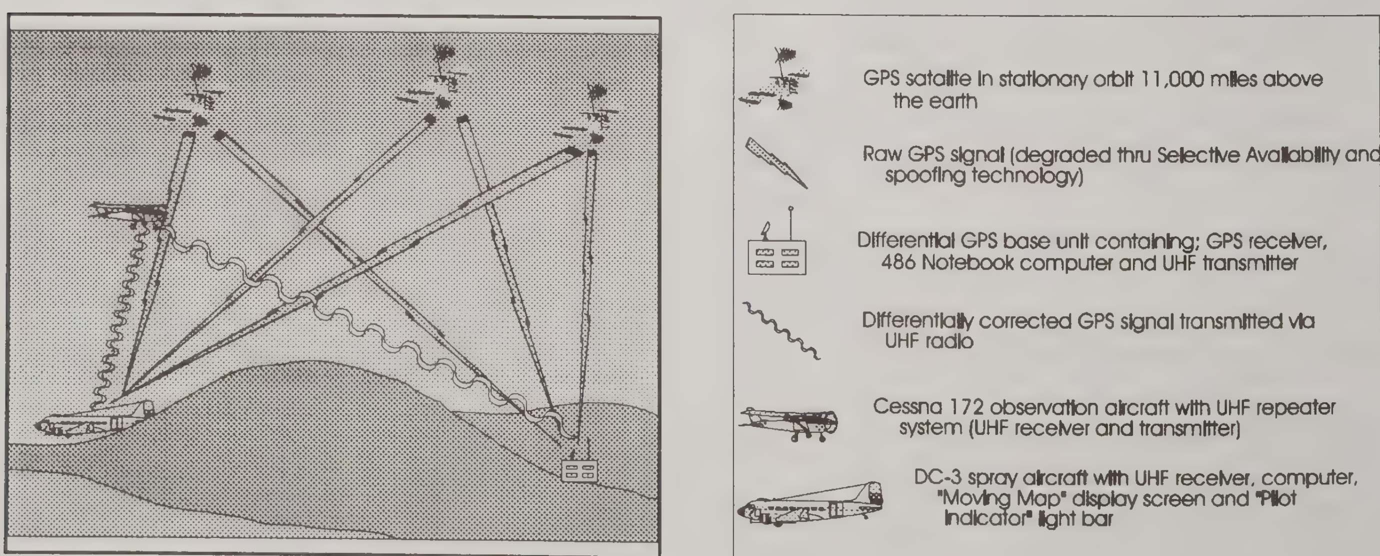
Global Positioning System (GPS)

The Global Positioning System (GPS) is the latest technology in navigation and location determination. GPS consists of a constellation of 24 NAVSTAR (Navigation Satellite: Timing and Ranging) satellites orbiting the earth at a distance of about 11,000 miles. This constellation has six orbits with four satellites in each orbit and a rotation of about 11 hours and 58 minutes for each satellite. The constellation was completed in 1993, and there are two 'spare' satellites also in orbit in case of a failure in one of the 24. The system provides 24-hour coverage over all of the earth's surface with 6-7 satellites visible at all times.

The system works by the satellites sending precisely-timed radio signals which are received by the GPS ground units. The receiver calculates latitude, longitude, and elevation or altitude by calculating the time it takes for the signal to reach the receiver. A minimum of three satellites are required to calculate latitude and longitude and a minimum of a fourth to calculate elevation or altitude. When using this system, your receiver can determine your location within 100 meters 95 percent of the time, your error is greater for the other 5 percent of the time.

The satellites and their signals are controlled by the Department of Defense which can evoke Selective Availability (SA) at their discretion. Through this SA, the broadcasted time and/or position of the satellites can be altered. This increases or decreases the error in location determination depending on the amount of SA invoked.

To eliminate most of the impact of SA, manufacturers have developed differential GPS (DGPS). This system requires the use of a stationary GPS receiver located at a known point on the ground. This ground unit is connected to a radio which transmits error corrections to the receiver of another GPS unit. The GPS units receiving this correction information can determine their location to within three feet or less.



GPS Spray Plane Guidance Used for 1994 Gypsy Moth/Spanworm Project on the Allegheny National Forest, Pennsylvania

Don A. Clymer and John R. Omer

The Allegheny National Forest (ANF) has been spraying *Bacillus thuringiensis* var. *kurstaki* (*Bt*) for control of gypsy moths in varying amounts since 1984. Prior to this year, the largest project was 40,000 acres (12,000 acres double treatment) in 1989, with an average year being 20,000 acres or less. A normal project of 20,000 acres involved using an ICS organization of 30 people to monitor the spraying and loft balloons to mark the spray block boundaries.

The spray project this year consisted of 55,762 acres of treatment for elm spanworm and 17,557 acres (8,191 acres double treatment) for gypsy moth, for a total of 73,319 acres in 66 blocks. In addition to increased acreage, the spanworm spray blocks were spread over most of the eastern half of the Forest and not grouped together like the gypsy moth (oak type) spraying has been in the past. As a result we were considering the use of more than 50 people at a cost of approximately $100,000 in order to balloon the spray blocks this year. Even at this cost, the job would have been very difficult. Many of the balloon locations were in remote locations requiring a crew to "bushwack" a mile or more and making them unavailable to place other balloons that day.

In March our contractor, K & K Aircraft, proposed offering us the additional service of DGPS spray plane guidance rather than using balloons. We agreed on a contract modification that required K & K Aircraft to acquire a DGPS spray plane guidance system for at least 2 airplanes and use this system on at least 80 percent of this year's project acreage. The project was completed using two DC-3's equipped with AgNav guidance systems obtained from Pestechcon, Inc., Swanton, Vermont. The GPS system consisted of the 2 spray plane computer and guidance systems, a base station to provide differential correction, a digitalizing table for programming the spray blocks, and a repeater which was installed in one of the surveillance aircraft to ensure correction was received by the spray planes over the full extent of our 40-mile spray area.

The system worked better than we anticipated. The ability of the guidance system to link together several adjacent blocks and treat them as one large unit was very advantageous, and resulted in some straight spray runs of up to 8 miles. Coupled with this was the capability to restart spraying where a previous load ended, even in mid-swath, by either plane. Some of these large units were simultaneously treated by both DC-3's, one plane working the west side to the middle, and the other working the middle to the east side.

The DGPS guidance system was a 2-person crew operation: The pilot had "heads up" for outside and watched the light bar which provided the guidance. The second in command monitored the "real time" moving map display and did the required inputing to the guidance system.

The only technical problems were a faulty antenna connection on the base station and a faulty modem in the repeater. Neither problem disrupted spraying. The antenna connection was repaired within hours and spraying continued in the interim using a portable antenna. The modem in the repeater was replaced in 2 days, and during the interim, the spray planes received differential correction directly from the base station, which was converted to a portable mode and located near the spraying for that day.

We had more problems with operator error than technical problems. The spray blocks were being digitalized a few days, or in some cases, a few hours before spraying. This left little time for checking or double-checking for errors.

Our first "overspray" was caused by mapping error: a parcel of private land had not been delineated within a spray block, was therefore not digitalized as an "out" area, and was sprayed. Next we had three digitalizing errors caused by incorrect corners or corner coordinates. In using a digitalizing table, if the corners of the map are incorrect, all the spray blocks on that map are "scrunched" smaller, or "stretched" larger, or mislocated. In one of these cases, the pilots never did get oriented and completed the spray using the terrain and guidance from the surveillance aircraft. In the other two cases, the error was less and resulted in small oversprays. They were not confirmed until after the spraying had been checked on the TV screen on the ground.

The spray plane guidance system saved the government approximately $75,000 this year. We accomplished the project using only 12 government employees for monitoring, guidance, and data collection. And we have a permanent record of the treated areas which we can add to our GIS data base.

The accuracy of the DGPS guidance system is a definite advantage: In prior years, we wouldn't know we had an overspray unless it was either so large that the pilot couldn't make the *B.t.* "stretch" to finish the block, or we received a phone call informing us someone was sprayed. Next year, we plan to digitalize the spray blocks in the winter and check and double check to prevent errors that result in oversprays.

K & K aircraft used four different captains on the project, none of whom had used this DGPS spray plane guidance system before, although some of them had used another DGPS system. They were all pleased with the system and quickly adapted to it. K & K Aircraft stated that two contributing factors to the success of the new system was the computer capability that one of their employees had, and the excellent support they received from the DGPS system manufacturer.

About the Authors

Don is a Forester with the USDA Forest Service's Allegheny National Forest in Warren, PA 16365

John is an Entomologist with the USDA Forest Service's, Forest Health Protection Staff in Morgantown, WV 26505

Find Us on the Internet

Read the ***Gypsy Moth News*** without sacrificing trees to do it! Try the Internet!

The ***Gypsy Moth News*** is now available as a popular roadside attraction along the Information Highway. Sandy Liebhold, our worldwide web facilitator, brings the ***News*** to you in its absolute (really) entirety. The address of the ***News*** is:

http://gypsy.fsl.wvnet.edu

This will take you to the Gypsy Moth Home Page, where you will find the ***News***, as well as, other interesting information about the gypsy moth. An e-mail discussion group is also available.

For best viewing results, try a graphic web browser such as Mosaic. Otherwise, you'll miss the pictures.

New Publication

The Spray Swath of the DC-3 for Gypsy Moth Suppression using *Bacillus thuringiensis* *by* John Ghent, Forest Health, Asheville, NC, and Daniel B. Twardus, Forest Health Protection, Morgantown, WV. 1994. USDA Forest Service NA-TP-05-94.

Comprehensive evaluation of swath width using card line data from field trials and the spray deposition model, AgDisp. The report includes a sensitivity study of several key variables affecting the deposition of released spray material into the wake of a DC-3. The sensitivity study was conducted by Dr. Milton Teske of Continuum Dynamics, Inc., Princeton, New Jersey.

For copies, contact the ***News*** or for information about the evaluation, contact John Ghent at 704-257-4328.

Letter to the Editor

B.R. from Kent, Ohio, asks:

"Can we manage gypsy moth through trunk injection?

Richard Reardon, Entomologist with the National Forest Health Management Center, responds:

ACECAPS (Medicap systemic implantation cartridges containing powdered acephate and manufactured by Creative Sales in Fremont, NE) are registered by the US-EPA for control of the gypsy moth. In a study by Webb et al (1988), ACECAP treatment reduced defoliation and gypsy moth egg populations significantly over a wide range of conditions. Treatments should be timed for, or just after, budburst. In another study, Reardon and Webb (1990) evaluated twice-treated (treated in 1984 and 1985) and once-treated (treated only in 1985) oaks. Both treatments provided foliage protection and population reduction. However, the response of white oak to the implantation process was more severe with regard to discolored xylem tissue then that for red oak or black oak. Also, with many white oaks, wounding produces the development of extreme radial shakes in the phloem tissue which can extend up to four meters above the specific implantation site.

Literature Cited

Webb, R. E. et al. 1988. Suppression of gypsy moth populations on oak using implants or injection of acephate and methamidophos. J. Econ. Entomol. 81:573-577.

Reardon, R. C. and R. E. Webb. 1990. Systemic treatment with acephate for gypsy moth management: population suppression and Wound Response. J. Arboric 16:174-178.

☆ U.S. Government Printing Office: 1995 — 605-347